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(54) History-based document differencing showing nature of differences

(57) Electronic document version management for multiple versions of an electronic document displays the nature of the changes made between versions of an electronic document.

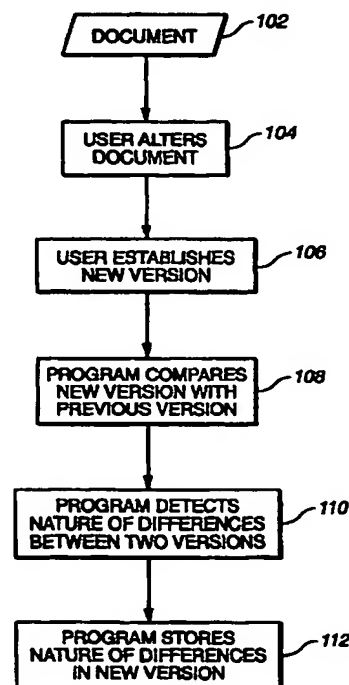


FIG. 1

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## Descripti n

### BACKGROUND OF THE INVENTION

[0001] The present invention relates to version 5  
management of electronic documents.

[0002] When an electronic document is revised by  
different people, and when previous versions must be  
preserved, it is important for a document editing and  
management system to be able to manage multiple ver- 10  
sions of a document.

[0003] Current version management systems pro-  
vide numerous methods for detecting, recording and  
providing notification of alterations made between two  
versions of a document. One system uses pointers 15  
shared by a plurality of versions for indicating active  
lines of a version. Other systems use version history  
tables or files to show the differential page content and  
field content between versions.

### SUMMARY OF THE INVENTION

[0004] The invention provides electronic document  
version management in a way that manages multiple  
versions of an electronic document and displays the 25  
nature of the differences made between versions of an  
electronic document.

[0005] Advantages that can be seen in implementa-  
tions of the invention include one or more of the follow-  
ing. The invention provides a user with a version history  
of an electronic document showing the nature of the dif-  
ferences made between two versions. It does so without  
having to recalculate the nature of the differences each  
time the electronic document is opened. Because the  
user sees the nature of the differences instead of the 35  
differences themselves, the user can quickly confirm  
that only differences of an appropriate kind have been  
made to a document. For example, where the original  
document is a form that has fields that will be filled in by  
one or more people and in the process be approved by 40  
one or more people, a person viewing a final version  
can see at a glance from the version history who has  
altered the document and the kinds of changes each  
person has made. For example, the version history can  
provide a summary of the number of changes made to 45  
previously-blank fields or previously filled-in field values  
of the document.

[0006] The details of one or more embodiments of  
the invention are set forth in the accompanying draw-  
ings and the description below. Other features and  
advantages of the invention will become apparent from  
the description, the drawings, and the claims.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

FIG. 1 is a flowchart of a process for processing an

electronic document in accordance with the inven-  
tion.

FIG. 2A shows a document in its original form.

FIGS. 2B and 2C show altered versions of the doc-  
ument.

FIG. 2D shows an altered version of the document  
on a user interface.

[0008] Like reference numbers and designations in  
the various drawings indicate like elements.

### DETAILED DESCRIPTION

[0009] FIG. 1 shows a process suitable for imple-  
mentation in a computer program application for  
processing an electronic document of a kind that can  
have a sequence of versions beginning with an original  
version and ending with a current version. For example,  
the process is suitable for use with documents that have  
fields that are filled in by one or more users to create a  
sequence of versions. The application need not limit  
alterations to filling in fields, however. The versions may  
differ arbitrarily from one version to the next. Also, a  
document does not have to be stored in a single data  
file in a computer file system. A document can be stored 25  
in a portion of a file that holds other documents, in a sin-  
gle file dedicated to the document in question, or in a set  
of coordinated files, stored in the file system of one  
computer or distributed over multiple computers.

[0010] When the application displays the docu-  
ment, the user typically views a portion of the current  
version of the document 102. One or more users may  
alter the current version of the document (step 104),  
and at some point a user establishes a new version  
(step 106). Generally, this will occur after a single user  
has completed making changes to the document and  
has closed the editing session, for example, by saving  
the document to non-volatile storage, such as a disk file,  
or by forwarding the document to another user in a doc-  
ument approval and review system.

[0011] FIG. 2A shows an original version of a two-  
page document 202 with blank fields prior to any altera-  
tions. Alterations may be made to the document's field  
content by filling in previously blank fields 208, or by  
changing previously filled-in field values 210. Alterations  
may also be made to the document's general content by  
editing the pages 206 of the document. The term gen-  
eral content will be used to all font and image informa-  
tion in a document outside the fields.

[0012] Returning to FIG. 1, when the user estab-  
lishes a new version of the document, the document as  
it existed before any alterations is preserved as the pre-  
vious version in the sequence of versions, and the new  
version becomes the current version. The application  
compares the new version with the previous version 55  
(step 108) and detects the nature of alterations between  
the two versions (step 110). In one implementation, the  
nature of the alterations is defined according to a taxon-

omy that includes the following types of alterations: (i) changes to previously filled-in fields; (ii) changes to previously blank fields; and (iii) changes to the general content of a page. The alterations are detected on a page-by-page basis. In alternative implementations, the granularity can be larger or smaller; for example, the alterations can be detected on a paragraph-by-paragraph basis, section-by-section, or otherwise.

**[0013]** The application stores the nature of the alterations (step 112) in the document as a version history. This can be done using any technique for adding information or properties to a document, such as by appending a version object to the document. In one implementation, the application determines whether the general content of a page has changed by calculating a hash function (such as MD5) of the current and previous version of the same page by order in the document. Similarly, the application determines whether the content of the individual fields has changed, and if so, whether the change was from a blank or a non-blank content. This information is stored as three numbers associated with the now-current version in the version history of the document.

**[0014]** As shown in FIG. 2B, the application can display, floating over the display of the document, the number of each type of alteration from the previous version to the displayed version of the document. These numbers provides an at-a-glance summary of the nature of the alterations made between the displayed and the immediately-previous version of the document. The version history 212 in FIG. 2B shows that after a user filled in eight previously-blank fields 208 and made no other changes, the user established a new version 204 in the sequence of versions. The version history 213 shown in FIG. 2C shows that a user established a new version 214 of the document 204 by changing three previously filled-in fields 210 and editing the general content of one page.

**[0015]** As shown in FIG. 2D, the application can also display the document's version history in a pane 216 alongside the document 218 on a user interface 220. The version history can be collapsed by clicking the minus sign 222 or expanded by clicking the plus sign 224, for example. By collapsing the version history, the user views only select information about the document, such as the name of the user 226 that established a particular version of the document, as well as a date and time stamp 228 for that version, which can optionally be maintained in the version history of the document. Expanding the version history 230 provides the user with more information, including the nature of the alterations between two successive versions in the sequence of versions.

**[0016]** If a document is altered, the application maintains the previous version along with all earlier versions of the document. When a user views the document, the user typically views the current version. However, the other versions are available for viewing. If

a previous version is selected for viewing, the version history of the selected version can be displayed at the end of the document, in a pane alongside the document, or otherwise.

**[0017]** The application can optionally be configured to display a document's cumulative version history up to a selected version, or to display a version history comparison between two non-contiguous versions selected by a user, or to display version histories for a range of versions selected by a user.

**[0018]** The invention can be implemented in digital electronic circuitry, or in computer hardware, firmware, software, or in combinations of them. Apparatus of the invention can be implemented in a computer program product tangibly embodied in a machine-readable storage device for execution by a programmable processor, and method steps of the invention can be performed by a programmable processor executing a program of instructions to perform functions of the invention by operating on input data and generating output. The invention can be implemented advantageously in one or more computer programs that are executable on a programmable system including at least one programmable processor coupled to receive data and instructions from, and to transmit data and instructions to, a data storage system, at least one input device, and at least one output device. Each computer program can be implemented in a high-level procedural or object-oriented programming language, or in assembly or machine language if desired; and in any case, the language can be a compiled or interpreted language. Suitable processors include, by way of example, both general and special purpose microprocessors. Generally, a processor will receive instructions and data from a read-only memory and/or a random access memory. Generally, a computer will include one or more mass storage devices for storing data files; such devices include magnetic disks, such as internal hard disks and removable disks; magneto-optical disks; and optical disks. Storage devices suitable for tangibly embodying computer program instructions and data include all forms of non-volatile memory, including by way of example semiconductor memory devices, such as EPROM, EEPROM, and flash memory devices; magnetic disks such as internal hard disks and removable disks; magneto-optical disks; and CD-ROM disks. Any of the foregoing can be supplemented by, or incorporated in, ASICs (application-specific integrated circuits).

**[0019]** To provide for interaction with a user, the invention can be implemented on a computer system having a display device such as a monitor or LCD screen for displaying information to the user and a keyboard and a pointing device such as a mouse or a trackball by which the user can provide input to the computer system. The computer system can be programmed to provide a graphical user interface through which computer programs interact with users.

**[0020]** The invention has been described in terms

of particular embodiments. Other embodiments are within the scope of the following claims. For example, the steps of the invention can be performed in a different order and still achieve desirable results.

## Claims

1. In a system for processing an electronic document of a kind having a sequence of versions, a method comprising:

comparing a new version of the electronic document with a previous version of the electronic document in the sequence of versions;  
detecting the nature of differences between the new version of the electronic document and the previous version of the electronic document;  
and  
storing the detected nature of the differences between the previous version and the new version of the electronic document.

2. The method of claim 1, wherein the previous version is the immediately previous version of the electronic document.

3. The method of claim 1, wherein the detected nature of the differences is stored in the electronic document.

4. The method of claim 3, wherein:

the detected nature of the differences is stored as a group of numbers, each number representing a count of the occurrences of a difference of a particular kind.

5. The method of claim 3, further comprising:

storing data in the electronic document representing the detected nature of differences between each pair of successive versions in the electronic document.

6. The method of claim 3, wherein:

the detected nature of the differences is stored in the electronic document when the new version of the electronic document is saved in a non-volatile memory.

7. The method of claim 3, wherein:

the detected nature of the differences stored in the electronic document is a summary that provides less information than is required to produce the new version from the previous version of the electronic document.

8. The method of claim 1, further comprising:

displaying a version history including the detected nature of the differences between the previous version and the new version of the electronic document.

9. The method of claim 1, wherein the electronic document is of a kind having general content and field content, field content comprising a field definition and a field value.

10. The method of claim 6, wherein the nature of the differences comprises:

whether or not the differences between the new version of the electronic document and the previous version of the electronic document include changes to previously-blank fields;  
whether or not the differences between the new version of the electronic document and the previous version of the electronic document include changes to previously filled-in field values; and  
whether or not the differences between the new version of the electronic document and the previous version of the electronic document include other changes.

11. The method of claim 6, further comprising:

displaying a version history including the detected nature of the differences between the previous version and the new version of the electronic document.

12. The method of claim 6, wherein:

the electronic document is an electronic form having fields to be filled in by one or more users to create one or more versions.

13. The method of claim 1, wherein the versions in the sequence of versions are all stored in one or more named files in a computer file system.

14. In a system for processing an electronic document of a kind having a sequence of versions, a method comprising:

displaying on a display device for viewing by a user a version history of an electronic document showing the nature of differences between successive versions of the electronic document.

15. The method of claim 11, wherein the nature of differences comprises:

whether or not the differences between successive versions include changes to previously-blank fields;

whether or not the differences between successive versions include changes to previously filled-in field values; and 5

whether or not the differences between successive versions include other changes.

16. The method of claim 11, wherein the nature of differences is displayed as a group of numbers, each number representing a count of the occurrences of a difference of a particular kind, each number being displayed with text describing the particular kind of difference represented by the corresponding number. 10 15

17. The method of claim 11, further comprising:

reading the version history from the document. 20

18. A computer program product, tangibly stored on a computer-readable medium, for processing an electronic document of a kind having a sequence of versions, the product comprising instructions operable to cause a programmable processor to: 25

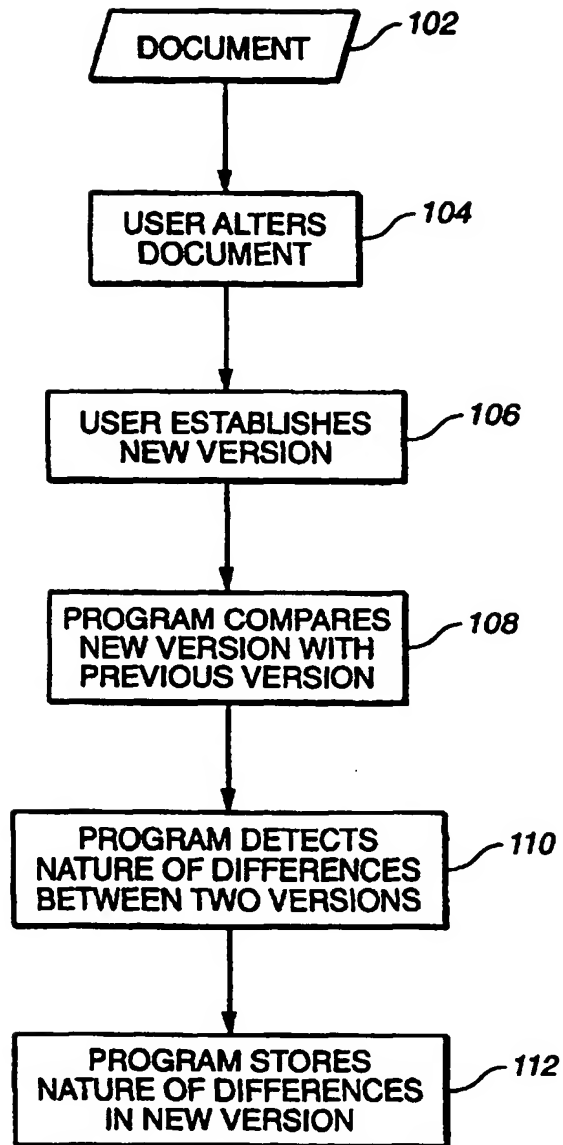
compare a new version of the electronic document with a previous version of the electronic document in the sequence of versions; 30  
detect the nature of differences between the new version of the electronic document and the previous version of the electronic document; and  
store the nature of the differences in the electronic document. 35

19. A computer program product, tangibly stored on a computer-readable medium, for processing an electronic document of a kind having a sequence of versions, the product comprising instructions operable to cause a programmable processor to: 40

display on a display device for viewing by a user a version history of an electronic document showing the nature of differences between successive versions of the electronic document. 45

50

55

**FIG. 1**

<p>Team <input type="text"/></p> <p><input type="text"/></p> <p><input type="text"/></p> <p><input type="text"/></p> <p style="text-align: right;">1</p>	<p><b>EXPENSE REPORT</b></p> <p>Enter Project Name <input type="text"/></p> <p>Reports Update as of <input type="text"/></p> <p>Estimated Total Cost \$ <input type="text"/></p> <p>Team Expenses \$ <input type="text"/></p> <p style="text-align: right;">2</p>
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**FIG. 2A**

202

<p>Team <input type="text" value="1"/> <span style="float: right;">208</span></p> <p><input type="text" value="Jane Cooper"/> <span style="float: right;">208</span></p> <p><input type="text" value="David Jones"/> <span style="float: right;">208</span></p> <p><input type="text" value="John Smith"/></p> <p style="text-align: right;">1</p>	<p><b>EXPENSE REPORT</b></p> <p>Enter Project Name <input type="text" value="Digidoc"/> <span style="float: right;">208</span></p> <p>Reports Update as of <input type="text" value="05/09/1999"/></p> <p>Estimated Total Cost \$ <input type="text" value="1500"/> <span style="float: right;">208</span></p> <p>Team Expenses \$ <input type="text" value="386"/></p> <div style="border: 1px dashed black; padding: 5px; margin-top: 10px;"><p style="text-align: center;">212</p><p># of changes to previously blank fields = 8</p><p># of changes to previously filled-in fields = 0</p><p># of pages with changed general content = 0</p></div> <p style="text-align: right;">2</p>
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**FIG. 2B**

204

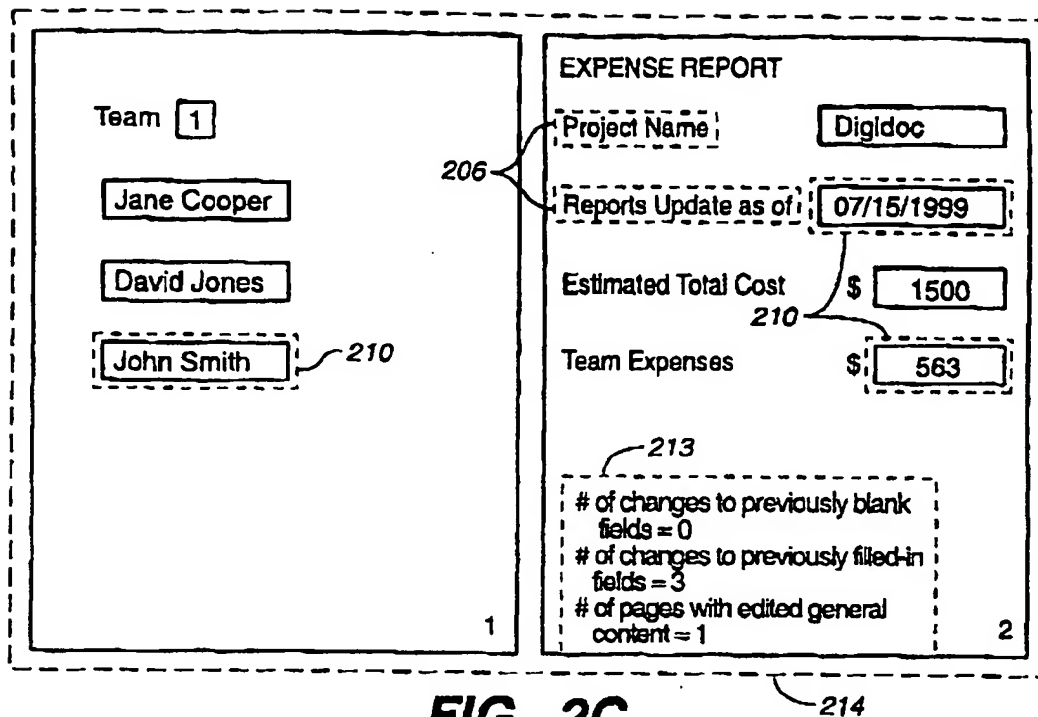


FIG. 2C

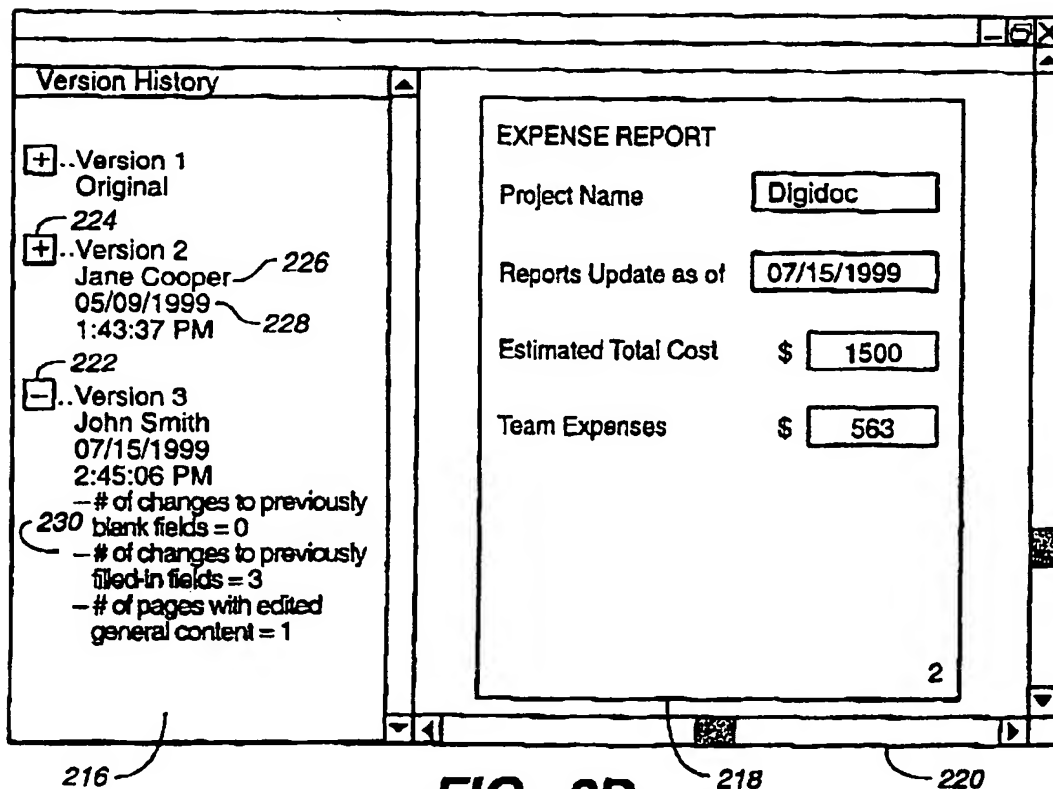


FIG. 2D